



## City of Burlington Stormwater Management Program MS4 Annual Report for Calendar Year 2016

In accordance with State of Vermont permit 7022-9014.A issued to the City of Burlington on December 11, 2017, we are submitting the following annual report documenting stormwater activities completed in calendar year 2017.

### 1) Minimum Measure 1- Public Education and Outreach

- In 2017, the Regional Stormwater Education Program (RSEP), was officially rebranded as Rethink Runoff – therefore any references from here on out to compliance with MCM1 will be to Rethink Runoff.
- Total Payment made to Rethink Runoff: **\$5,500**
- Total Online Media Impressions: **9,981**
- # visitors to the Rethink Runoff website: **6,549**
  - Rethink Runoff web address: [www.rethinkrunoff.org](http://www.rethinkrunoff.org)
- Maintenance/continued update of municipality's stormwater website
  - <http://www.burlingtonvt.gov/DPW/Stormwater-Management>
- Additional Public Education/Outreach completed in Burlington as part of Integrated Water Quality Planning Efforts. See: <http://bit.ly/1RyvwoI>
- Supplemental information for MM 1 can be found in **Appendix 1**

### 2) Minimum Measure 2 – Public Involvement and Participation

- Payment made to the Chittenden County Stream Team (CCST): **\$0**
  - CCST website address: <http://www.ccstreamteam.org>
  - Outreach Participation: **303**
  - Hands On Participation: **129**
  - Total # of 'likes' on the CCST Facebook Page: **177**
- Green Up Day
  - Amount of Trash collected: **830 bags, 1.5 tons**
  - # of tires collected in Burlington: **2,300**
  - # of cubic yards of scrap metal collected: **30**
  - # of participants: **671**
- Supplemental information for MM 2 can be found in **Appendix 2** (CCST Annual Report)
- Adopt a Drain Program: <http://www.burlingtonvt.gov/DPW/ADOPT-A-DRAIN>
  - Number of new drains adopted: **28**
  - Number of new drain adopters: **14**

### **3) Minimum Measure 3 – Illicit Discharge Detection and Elimination**

- Number of stormwater outfalls inspected: **9**
- Number of stormwater outfalls sampled/tested: **1**
  - We have secured a contract with Watershed Consulting Associates to begin in the Spring of 2018, to conduct an updated IDDE assessment City-wide, and develop a Standard Operating Procedure for City staff moving forward.
- Illicit discharges detected and eliminated: **1**
  - We had one sewer line break last winter on Riverside Avenue, which happened to occur just over a perforated storm pipe that discharged to the Winooski. The discharge was reported to ANR, the line was repaired, and the signage procedures were followed. Follow up sampling showed that repair of the break addressed the illicit discharge.
- Stormwater Infrastructure Mapping
  - Mapping updates continue as needed
  - Up to date sewer mapping is available at: <http://www.burlingtonvt.gov/DPW/Mapping-Links>
  - Draft sewershed/watershed mapping is available city wide, see: <http://arcg.is/190ncqo>

### **4) Minimum Measure 4 – Construction Site Runoff Control**

- Number of project local EPSCs reviewed: **66**
- Number of construction site inspections: **4**

### **5) Minimum Measure 5 – Post Construction Runoff Control**

- Number of project stormwater management plans reviewed: **27**
- Number of small stormwater management systems (no State permit) inspected: **1**
- Number of public stormwater management systems inspected/maintained:
  - 11 Infiltration Chamber System
  - 1 swirl separator
  - 8 rain gardens
  - 2 underground sand filters
  - 1 pervious asphalt parking area
  - 2 pervious paver sidewalk installations
- City Projects related to Post Construction Runoff Control in MS4
  - 2 sub-surface chambers installed at the bottom of King Street
  - 1 subsurface infiltration system installed on Russell Street

### **6) Minimum Measure 6 – Pollution Prevention and Good Housekeeping**

- # of catch basins inspected: **450**
- # of catch basins cleaned: **450**
  - Stormwater Vactor was inoperable for portions of the year, and was diverted for assistance with water line replacement work, resulting in a reduced # of catch basins being cleaned

- Operational updates are in progress for 2018 to ensure the Stormwater Vector is not being diverted for other work
- # of manholes inspected: **5**
- # of manholes cleaned: **5**
- Linear feet of storm lines cleaned:
  - **None documented during 2017**
- # of catch basins repaired: **25**
- # lane miles swept: **2523**
- # of dog bags distributed: **~120,000**
- # of cubic yards of material collected by street sweeping:
  - Street sweeping: **1,211**
- MCAP Audit completed: **No** (last done in 2008, will occur again this permit cycle)
- Trainings attended by City staff:
  - 2017 NEWEA Conference (GIS Technician)
  - Green Stormwater Exchange Workshop – Portland, OR (SW Program Manager)
  - WEFTEC 2017 Conference (SW Program Manager)
  - Streep Sweeping Study Kickoff with USGS (SW Program Manager)
  - WNRCD / UVMMSG De-Icing Conference (SW Program Manager, several DPW field staff)
  - Numerous other webinars and training opportunities
- Municipal Repair/Good Housekeeping Projects:
  - Outfall repair and stabilization at Gazo Avenue,
  - Subsurface infiltration installed on Russell Street to address ponding in road,
  - Catch basin replacements completed on East Avenue in conjunction with paving work.

## **7) Other Stormwater Activities and Reporting**

- FY19 Stormwater Budget Proposed Expenses: **\$2,102,110**
- Update in geospatial data will result in approximately \$80,000 in additional revenue starting in FY19
- Current Stormwater rates per ISU (1000 sq. ft.)
  - \$6.60/month for a Single Family Home;
  - \$6.56/month for a Duplex;
  - \$7.56/month for a Triplex
  - (see: <http://www.burlingtonvt.gov/DPW/Billing>)

## **8) Flow Restoration Plan (FRP) Development Progress (Part IV.C.1.e.1)**

- The City of Burlington finalized edits requested to their Flow Restoration Plans (FRPs), and those plans became final in the Fall of 2017.
- The City is currently working on obtaining final cost estimates for implementation of Retrofit M10 in the Englesby Brook FRP – installation of an Opti “Smart Valve” in the ‘08’ Pond.

#### **9) Implementation of “BLUE® BTV” Technical Assistance Program for Landowners (Part IV.C.1.e.4)**

The BLUE BTV Program was rolled out in the Spring of 2017, and is still ongoing. To date, the program has resulted in the disconnection of 2,866 square feet of impervious surface.

#### **10) Flow Monitoring Progress (Part IV.C.1.e.7)**

The City executed the MOU for the joint Flow Monitoring in 2016, and that project is ongoing.

#### **11) Expired Permits Progress (Part IV.C.1.e.3)**

Per the request of the State Stormwater Program staff last year, we have still tentatively decided not to take over any expired permits. However, per our October 1, 2015 interim report to the State, until the State releases the RDA permit and EFA, we do not anticipate making a final decision regarding whether the City will incorporate these permits into the City’s MS4 or petition the State to RDA these expired permits.

#### **12) Plans/Projects for Permit Year 2018**

- Ongoing development of Integrated Water Quality Management Plan:  
<http://www.burlingtonvt.gov/DPW/Stormwater/IMSWP>
- Continue development of Formal Asset Management Plan for Stormwater infrastructure
- Repair outfall and stabilize bank erosion issues on Route 127
- Continue implementation of the outfall prioritization and repair project currently underway with Stantec Consulting
- Continue implementation of the IDDE project now underway with Watershed Consulting Associates
- Conduct a citizen training on the Adopt-A-Drain Program to improve participation and engagement with that initiative
- Purchase and implement use of chloride application equipment for DPW’s road de-icing fleet
- Schedule and host a chloride-application training for DPW’s winter maintenance staff with Green Snow-Pro consultant Patrick Santoso from New Hampshire (in collaboration with other Chittenden County MS4’s)
- Establish and adopt design standards under the City’s Chapter 26 Ordinance
- Address comments on FRP’s provided by the Stormwater Program

### **13) Proposed Changes**

- An updated SWMP will be provided with the City's forthcoming MS4 renewal application once the new MS4 General Permit is issued.

### **Certifications:**

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."



Jenna Olson  
Stormwater Program Manager

3/28/18

Date Signed

**Appendix 1:**  
Supplemental Information for  
Minimum Measure 1

# **MCM #1**

## **REGIONAL STORMWATER EDUCATION PROGRAM**

**JANUARY–DECEMBER 2017  
SUMMARY OF ACTIVITIES**

**PREPARED BY  
PLUCK**

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Since 2003, Chittenden County's twelve MS4s have worked to pool resources to professionally engage the public in a one message, one outreach effort known as the Regional Stormwater Education Program. Through regular Spring and Summer advertisements to drive people to the program's website, [www.smartwaterways.org](http://www.smartwaterways.org), this cooperative approach to fulfilling their NPDES Permit Minimum Measure #1 requirements has built a regional awareness among the public of the need for individual action to assist in fighting stormwater problems.

Beginning in the summer of 2016, the MS4s contracted with Tally Ho through their Lead Agency, the Chittenden County Regional Planning Commission, to rebrand the Smart Waterways campaign into a combined effort with the MS4's Minimum Measure #2 regional effort known as the Chittenden County Stream Team. The goal was to create one cohesive organization and outreach effort to both educate the public about stormwater and boost public participation in implementation of projects to combat the negative impacts of stormwater. In spring of 2017, Rethink Runoff was publicly launched, including a new website and revised creative.

This 2017 Calendar Year report recaps the performance of the Regional Stormwater Education Program and describes the work done related to the new combined Minimum Measures #1 and #2 effort known as "Rethink Runoff."

### **REBRAND AND WEBSITE REDESIGN**

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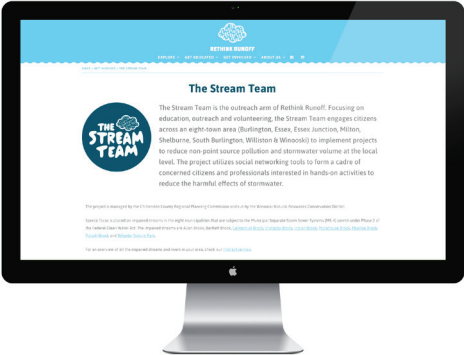
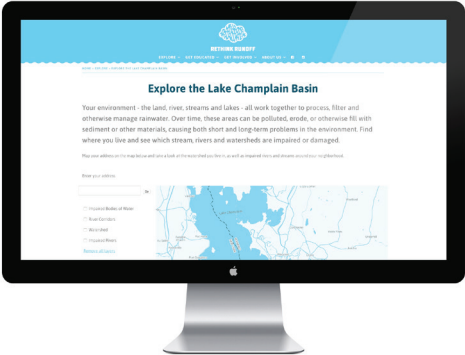
Tally Ho Design rebranded Smart Waterways as Rethink Runoff in spring 2017. Rethink Runoff combines both the existing Smart Waterways campaign and the Chittenden County Stream Team into one organization. The Chittenden County Stream Team continues as a sub-set of the larger brand, serving as the outreach arm of Rethink Runoff.

As part of that initiative, Tally Ho also redesigned and reprogrammed a new website, combining information and content from both the previous Smart Waterways website and the Stream Team website under the new URL, [www.rethinkrunoff.org](http://www.rethinkrunoff.org).

In addition to the new visual brand and website design, we created digital and print advertisements, stickers, T-shirts, and stencils for outreach.



# RETHINK RUNOFF





## SPRING AND SUMMER CAMPAIGNS

Spring, summer, and fall campaigns were run by Tally Ho Design. Messaging from previous campaigns was redesigned into the Rethink Runoff brand. Video and radio creative was left intact, save for an updated URL at the end of each. With that in mind, television ad buys were minimized while digital advertising was increased, specifically using the Google Ad Network. Using the Google Ad Network allowed specific tracking to reach our target audience by geographic location, age, and interests, among other factors.

### SPRING 2017

Below is a cost breakdown of media buys, compared with spring 2016. Overall, we reduced our television spend and increased our online digital ad spend.

SPRING 2016 – MEDIA BUYS ACTUAL			SPRING 2017 – MEDIA BUYS, BUDGETED		
SOURCE	COST	PERCENTAGE	SOURCE	COST	PERCENTAGE
PRINT	\$2,500	12.5%	PRINT	\$1,755	10.0%
RADIO	\$4,500	22.5%	RADIO	\$3,088	17.6%
ONLINE	\$7,500	37.5%	ONLINE	\$10,650	60.9%
TV	\$5,500	27.5%	TV	\$2,015	11.5%
TOTAL	\$20,000	100.0%	TOTAL	\$17,508	100.0%

Our actual spend differed from our initial budget, as we adjust Google Adwords spends based on performance. As a result, we were able to continue running our Adwords campaign on/off throughout the summer. We continued to run display ads between 5/27–8/02 before our Fall Campaign started.

SPRING 2017 MEDIA BUYS, BUDGETED		SPRING 2017 MEDIA BUYS, ACTUAL 04/15–05/27		LATE SPRING/EARLY SUMMER 2017 MEDIA BUYS, ACTUAL 05/28–08/02	
SOURCE	COST	SOURCE	COST	SOURCE	COST
PRINT	\$1,755	PRINT	\$1,755	PRINT	-
RADIO	\$3,088	RADIO	\$3,088	RADIO	-
ONLINE	\$10,650	ONLINE	\$3,600	ONLINE	\$3,825.96
TV	\$2,015	TV	\$2,015	TV	-
TOTAL	\$17,508	TOTAL	\$13,191	TOTAL	\$3,825.96

In addition, we budgeted a small algae-bloom related campaign designed to run during beach closures. Our goal was to piggyback on local coverage of beach closures during the summer months. There were no large scale beach closures before school started. There was an algae bloom outbreak once school started. As a result, we trimmed some of our advertising buys, and ran digital ads related to algae blooms in tandem with the existing fall creative.

### FALL

Our Fall campaign continued the same display ads used in the spring. In addition, we introduced the algae bloom-focused ads, based on the mid-September algae bloom-related beach closing.

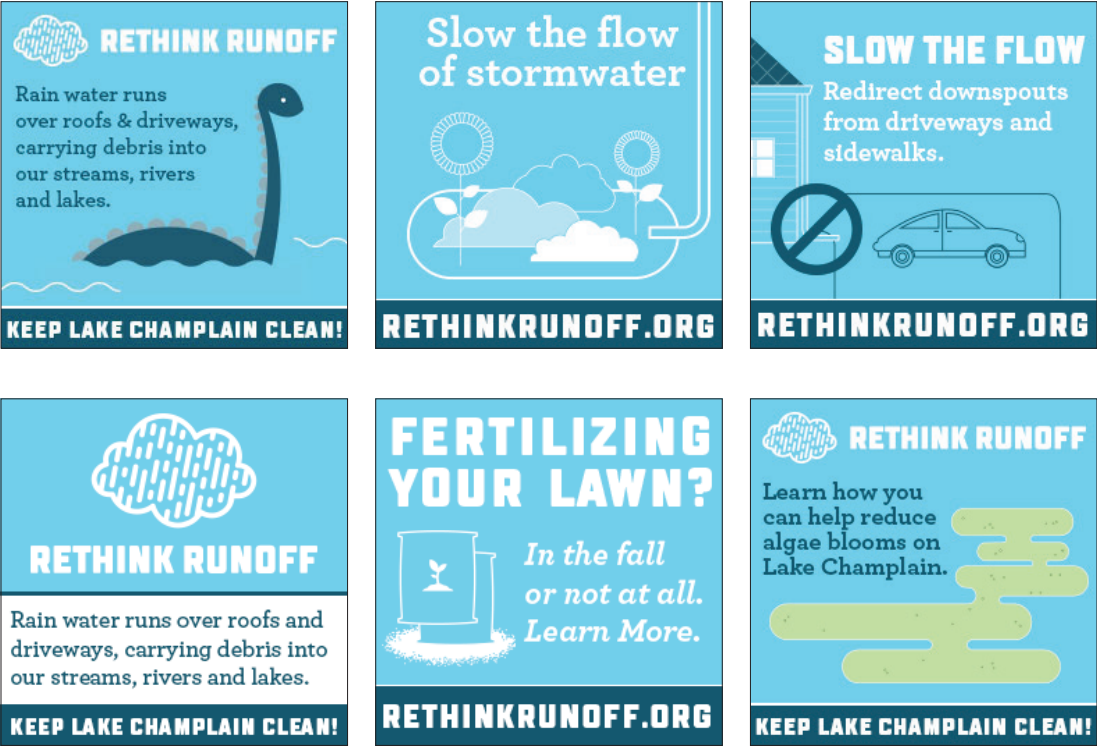
ALGAE BOOM MEDIA BUYS BUDGETED		FALL 2017 MEDIA BUYS, BUDGETED			08/03–10/01 FALL/ALGAE COMBINED MEDIA BUYS, ACTUAL		
SOURCE	COST	SOURCE	COST	PERCENTAGE	SOURCE	COST	PERCENTAGE
PRINT	\$585	PRINT	\$1,170	12.5%	PRINT	\$1,170	13.5%
RADIO	-	RADIO	\$1,080	22.5%	RADIO	\$1,080	12.5%
ONLINE	\$3,650	ONLINE	\$7,100	37.5%	ONLINE	\$4,582.69	52.9%
TV	-	TV	\$1,833	27.5%	TV	\$1,833	21.1%
TOTAL	\$4,235	TOTAL	\$11,183	100.0%	TOTAL	\$8,665.69	100%

CREATIVE—ADVERTISING

Advertising during year 1 included redesigned creative, incorporating existing messaging with a new visual language based on Rethink Runoff. Video and radio creative was modified to include a new URL, but otherwise remained the same.

Digital ads were created at the following sizes: 160x600, 200x200, 250x250, 300x250, 320x50, 336x280, 480x60, 640x360, 728x90, 970x90, 980x30. This allowed maximum distribution across the Google Ad Network.

SAMPLE 250x250 ADS



ANALYTICS FOR FY2017

TOTAL SESSIONS (1/1–12/31)

TOTAL	TIME PERIOD
7,407	2017
6,004	2016
4,659	2015
7,728	2014
3,541	2013
2,787	2012

TOP 10 VERMONT LOCATIONS (4/1–12/31)

TOWN	VISITS/PERCENT
Burlington	1165 (29.3%)
South Burlington	661 (16.6%)
Essex*	587 (14.7%)
Colchester	506 (12.7%)
Shelburne	181 (4.5%)
Montpelier	101 (2.5%)
Williston	100 (2.5%)
Stowe	83 (2%)
Milton	48 (1.2%)
Cambridge	43 (1%)

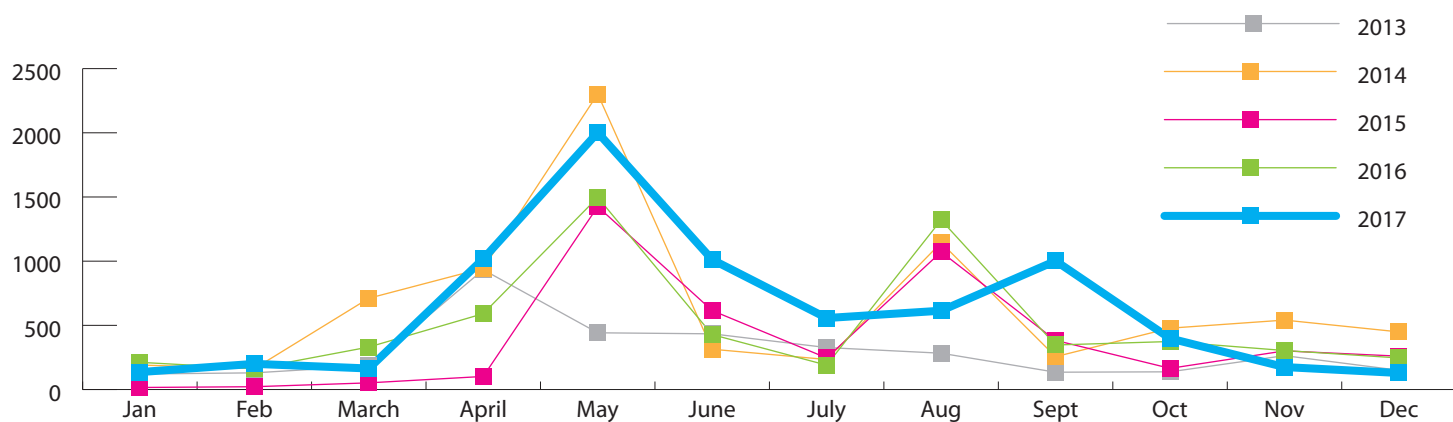
70.5% of total visitors were from Vermont.

\* also includes Essex Junction

DEVICE (4/1–12/31)

TYPE	VISITS/PERCENTAGE
desktop	50.94
mobile	37.71%
tablet	11.35%

## YEAR BY YEAR COMPARISONS OF SESSIONS



## ADVERTISING CLICK-THROUGHS

### SPRING 2017 DIGITAL ADVERTISING METRICS (THROUGH 5/27/17)

SOURCE	IMPRESSIONS	CLICKS	COST	COST PER CLICK
WCAX (DIGITAL)	130,000 impressions	488	\$1,100	\$2.25
GOOGLE AD NETWORK	pay-per-click	2,880	\$3,600	\$1.26

### SUMMER/FALL 2017 ADVERTISING METRICS (6/1–8/2)

SOURCE	IMPRESSIONS	CLICKS	COST	COST PER CLICK
GOOGLE AD NETWORK	pay-per-click	4,178	\$3,825.96	\$1.79

### FALL 2017 ADVERTISING METRICS (8/3-10/1)

SOURCE	IMPRESSIONS	CLICKS	COST	COST PER CLICK
GOOGLE AD NETWORK	pay-per-click	948	\$3,382.69	\$3.57
VTDIGGER.ORG	74,993 web	57	\$1,200	\$13.95
	Daily Digger email	29		

**Appendix 2:**  
Supplemental Information for  
Minimum Measure 2



## MCM #2

### Rethink Runoff Stream Team 2017 Summary of Activities

#### Social Media

##### Facebook

- 177 total “likes” - a 14% increase from 2016 (156 in at end of 2016)
- 179 total “follows”

#### RRST Website

Google Analytics provides website traffic data from: April 14th, 2017 (launch of new Rethink Runoff website) to December 31, 2017:

- 6,549 website visits; a 411% increase from 2016 (1,281 visits)
- 9,981 page views; a 302% increase from to the 2016 quantity (2,481 page views)
- 5,592 users

#### Newsletter and e-correspondence

- As of 12/31/17, there were **467** subscribers to the RRST newsletter. From 2015 - 2017, there was a 9% decrease in subscribers from 449 to 415. After the rebranding of Rethink Runoff, subscribers climbed back up to 467, which is a 13% increase in 2017 and the highest subscription to date.
- In previous years, newsletters outlined what had been accomplished. This year RRST shifted the focus of newsletters to instead offer information on **upcoming events and volunteer opportunities** in an effort to increase engagement in the program.
- A winter newsletter was sent out on 1/25 with a 36.2% open rate. A novel “promo” template was developed to increase outreach for specific events. A “Lawn Care workshop” promo and Colchester stenciling event promo were sent on 8/9 and 9/6, respectively. Each had a 29% open rate. A final winter newsletter was sent on 12/20, with an open rate of 18%. This lower open rate was likely due to fact that the newsletter was sent just before the Holidays.
- RRST E-News open rate is high. The typical open rate for similar industries is between 20-25% according to research completed by MailChimp.

#### Organizational Partnerships

The Rethink Runoff Stream Team partnered with 11 different organizations in 2017:

- Colchester Conservation Commission assisted RRST with hosting a rain barrel workshop at the Bayside Activity Center on 4/17. Five members of the Conservation Commission assisted with cleaning the rain barrels and helping workshop participants build their barrels. The PWD helped transport the barrels from Williston to Colchester.
- RRST partnered with the Essex Junction Parks and Recreation Department to enlist students from their CampSTAR program to stencil storm drains in the Village.
- RRST recruited staff from Lake Champlain Basin Program, Lake Champlain Sea Grant, and NECTAR Landscape Design to be presenters at the Stormwater-friendly Lawn Care Workshop on 9/20. High Mowing Seeds and Green Mountain Compost provided support through donations to



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this event.

- The South Burlington Natural Resource Committee presented RRST materials at their booth on Green-Up Day.
- The South Burlington Cub Scouts (pack 678) held a rain garden cleanup day on 9/16.
- A stormwater lesson was taught to the AP Environmental Science class at Colchester High School.

## Media

The Rethink Runoff Stream Team had **five** media appearances in 2017, exceeding the work plan goal of three articles:

- <http://www.essexreporter.com/perfect-storm-organization-seeks-conceptual-storm-drain-mural-designs/>
- <http://www.essexreporter.com/storm-drains-spruce/>
- <http://digital.vpr.net/post/what-can-be-done-about-vermonts-aging-sewer-systems#stream/0>
- <https://vtdigger.org/2017/04/25/chittenden-county-municipalities-rebrand-stormwater-awareness-program/>
- The lawn care workshop announcement was published only in print (a hard copy can be provided upon request).

## Outreach

Outreach includes any educational opportunities or tabling events where resources or information are provided to the community about the RRST program. There were **fourteen** outreach events in 2017, with an estimated total outreach to **432** people. Note: this total includes project events and workshops, as all events are used as opportunities to educate the public about the Rethink Runoff program.

- 2016 WQ data poster presented at Town Meeting Day for all **NINE** participating towns (3/7/17, 45+ people reached)
- Rain barrel workshop (4/17/17, 21 people reached)
- Town of Essex “Touch a Truck” Day tabling (5/6/17, 15 people reached)
- 6<sup>th</sup> Grade Conservation Day (stormwater and GSI lesson) (5/17/17, 48 people reached)
- South Burlington “Day of Play” Day tabling (6/3/17, 23 people reached)
- Volunteer Water Quality Training (6/20/17, 12 people reached)
- Williston 4th of July Celebration tabling (7/4/17, 22 people reached)
- Essex Junction Storm drain mural event (7/12/17, 71 people reached)
- Shelburne Harvest Festival (9/16/17, 60 people reached)
- South Burlington Fire Station rain garden cleanup (9/16/17, 37 people reached)
- Town of Essex lawn care workshop (9/20/17, 27 people reached)
- Milton Activities Fair (9/21/17, 43 people reached)
- Colchester stormwater lesson at Colchester High School (12/1/17, 8 people reached)

Outreach events in 2017 targeted the cities of South Burlington, Winooski, Williston and the Town of Essex (carried over from last year). RRST tabled at the Town of Essex “Touch a Truck” Day on 5/6, the South Burlington “Day of Play” Day on 6/3, and the Williston 4th of July Celebration on 7/4. A place was reserved for RRST at the Winooski Farmers Market on 10/8 but a major storm event persuaded staff to wait for a better opportunity in 2018 as turnout would likely have been low. RRST will make up for this lost outreach



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opportunity by attending a tabling event in spring 2018. RRST tabled at several other events (see list above) and hosted a number of education events in which information and resources about the program were shared.

The 2017 work plan goal for outreach participation was 300 people, which was surpassed by a total of 432 people that were engaged in outreach and educational opportunities in 2017. Outreach towns are selected from end-of-year event participation numbers and frequency of targeting a town. Chosen outreach towns for 2018 are Burlington, Milton, and Shelburne.

## Event-Driven Tasks

There were **nine** hands-on events held and the continuation of ongoing programs including, the Adopt a Rain Garden and Water Quality Monitoring. Education events are also included as they involved hands-on stormwater lessons (see Colchester project description for more detail).

- Rethink Runoff Rain Barrel Workshop (4/17/17)
  - Partnered with Colchester Public Works Department and Colchester Conservation Commission to carry out this event
  - 21 participants built 23 barrels
- 6<sup>th</sup> Grade Field Conservation Day (5/17/17)
  - A hands-on lesson on stormwater and GSI was given to 48 students from Essex (26 total) and Colchester (22 total)
- Village of Essex Junction Storm drain mural and stenciling event (7/12/17)
  - Three artists were contracted to paint storm drain murals on 7/12: one at the corner of Lincoln and Railroad Ave, and two in the parking lot of the Brownell library.
  - Over 50 people approached the artists to ask about the project. A handout about the project and the importance of addressing stormwater concerns was made for the artists to hand out to people passing by during the event.
  - Partnered with Essex Jct Parks and Recreation to acquire volunteers from their CampSTAR program. A total of 15 (11 students and 4 adults) assisted RRST with stenciling the new storm drain stencils along Countryside Dr., Tamarack Dr., and Beech St.
- Town of Essex Stormwater-friendly Lawn Care workshop (9/20/17)
  - Partnered with Lake Champlain Sea Grant, Lake Champlain Basin Program, and NECTAR Landscape Design to hold educational workshop. Colleen Hickey (LCBP) provided a State of the Lake presentation, Kris Stepenuck (LCSG) a talk on Natural Lawn Care Practices, Annie White (NECTAR) a talk on Stormwater-friendly Landscaping, and Becky Tharp (LCSG) a presentation on DIY Green Stormwater Infrastructure.
  - A total of 45 people signed up for the 25-person space workshop. A total of 27 participants attended the event (not including presenters and partners, which totaled 35 people).
  - Received donations from Green Mountain Compost (compost bin and cubic yard of compost) and High Mowing Seeds (organic vegetable and flower seed packets) to give away to participants.
  - Purchased and prepared 23 rain barrels to give away to 27 participants who attended the event.



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- Adopt A Rain Garden
  - Five of the eleven RRST-managed rain gardens were adopted in 2016.
  - A total of 59 individuals volunteered their time to maintain the gardens.
- Volunteer Water Quality Monitoring Training/Sampling
  - 12 volunteers assisted with the 2017 sampling season. All were trained at the 6/20 training session or subsequent trainings in the field.
  - Sampling occurred on five scheduled dates: 6/27, 7/11, 7/25, 8/8, 8/22; and two rain events: 7/17 and 8/18.
  - Volunteers were recognized for their dedication and work with pizza on 9/30.
  - 2017 water quality data report is currently being developed.
- South Burlington Fire Station rain garden cleanup (9/16/17)
  - Bill Kett and her Cub Scout Pack 678 agreed to adopt this rain garden in addition to the library rain garden. They met on 9/16 to spread mulch, weed, and replant bare sections in the rain garden.
  - Mary Desautels and Stephanie and Don Miner donated +\$200 in rain garden plants for the Fire Station garden in So Burlington.
- Colchester storm drain stenciling (9/30/17)
  - 20 catch basins were stenciled along West Lakeshore Drive.
- Colchester High School stormwater lesson (12/1/17)
  - A lesson on BMPs to reduce stormwater runoff and pollution was taught to Kara Lenovoritz's class. Seven students participated in this lesson and the Sea Grant Watershed Game to fortify the concepts learned.

Hands-on participation events in 2017 targeted the towns of Essex, Colchester, and the Village of Essex Junction. A storm drain mural and stencil event was held in Essex Junction on 7/14, a stormwater-friendly lawn care workshop was held in Essex on 9/20, and a storm drain stenciling event was held in Colchester on 9/30. Because of low-turnout in Colchester, an additional Colchester event was provided by way of a stormwater lesson for the Environmental Science class at Colchester High School on 12/1.

A total of 177 people participated in hands-on RRST events in 2017. A total of 90 people volunteered their time in a RRST activity in 2017; surpassing the 80 volunteer goal. Project towns for the following year are selected from end-of-year event participation numbers and frequency of targeting a town. Chosen project towns for 2018 are Williston, So Burlington and Winooski.

## **RRST Outreach Demographic Impacts**

The table on this next page displays the interaction from each of the nine MS4 communities at tabling events and 2017 project events and workshops. Please note: this is not a comprehensive list of all 432 people reached, as town residence was only acquired when offered.



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Town	# of participants
Burlington	15
Colchester*	45
Essex Town*	54
Village of Essex Junction*	93
Milton	42
Shelburne	25
Williston	37
South Burlington	93
Winooski	15

**Table 1: Interaction with RRSST by member town (asterisk identifies 2017 project towns)**

## **Village of Essex Junction Project: Storm drain mural and stencil event**

RRST coordinated a storm drain mural and stenciling event for the Village of Essex Junction in 2017. A “call for artists” was published by the Essex Reporter on May 31, 2017 and the opportunity was shared with artists involved in past RRSST projects. Three concepts were submitted and all were selected to be painted around three catch basins pre-selected with guidance from the Village’s Public Works Department. In addition to murals, a stenciling component was included in this project. Two designs were prepared by Tally Ho Design and six stencils were prepared by Stencils Online LLC for the event. The RRSST coordinator elicited volunteer help from the Village’s Parks and Recreation CampStar summer camp program.

On the morning of July 12, 2017, the three artists, Elizabeth Fanus, Syd Frolik-Roberts, and Emma Moreman were stationed at their assigned catch basins: one at the corner of Railroad and Lincoln Ave and the other two in the South Brownell library parking lot. The artists signed contracts stipulating the requirements and procedures they had to adhere to in order to participate in the project. Instead of traffic paint, primer and top coat were used to ascertain the longevity of the murals utilizing this new technique. Public Works staff assisted with thoroughly cleaning and laying down durable plastic under the drains. All murals were completed by the end of the day and Public Works staff returned to remove the plastic after the murals had dried.

Once artists were successfully underway, the RRSST coordinator met the CampStar group to undertake stenciling in a nearby neighborhood. A total of twelve campers, two adult camp coordinators, and two Public Works Department interns helped to stencil catch basins along the lengths of Countryside Drive, Tamarack Drive, and Beech Street. Prior to stenciling, the campers were brought over to see the artists working on their murals and were given a short lesson on stormwater and the importance of this work.



This document was prepared by the Winooski Natural Resources Conservation District, who is contracted by Chittenden County’s Ms4 Committee to run the RRSST program



The total estimated cost to plan, manage and implement this project was \$2,015. The approximate personnel time used to plan and execute the project was 26.5 hours or \$1,060. The artists were paid a \$250 stipend each; a total of \$750. The total supplies and half the stencil cost (other half of the expense included in the Colchester project estimate) was roughly \$190 and the mileage was \$15. The amount spent on this project was just over 8% of RRST's total FY18 budget.



*Essex Junction mural artists (pictured left) and CampStar stencilers (pictured right)*

## **Town of Essex Project: “Stormwater-friendly Lawn Care Workshop”**

The inspiration for this workshop stemmed from a growing movement of similar events offered throughout the country. In January 2017, RRST reached out to partner organizations and received pledges of support from the Lake Champlain Basin Program, Lake Champlain Sea Grant, and NECTAR Landscaping Design to provide staff to be presenters for the workshop. The event was held on 9/20/17 at a free, community room located in the Town of Essex Fire Station.

The purpose of this workshop was to provide skills, resources, materials, and advice to Chittenden County property owners on building healthier soils and managing stormwater runoff in their yards and lawns in ways that would protect local water quality. The agenda for the workshop was as follows:

5:00 - 5:15 pm - Participants sign in, get refreshments, find seats

5:15 - 5:30 pm - *State of the Lake: An update on the health of Lake Champlain*, Colleen Hickey,  
Education and Outreach Coordinator, Lake Champlain Basin Program



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5:30 - 6:00 pm - *Healthy Soil, Healthy Water: Best Lawn and Garden Practices*, Kris Stepenuck, Extension Leader, Lake Champlain Sea Grant

6:00 - 6:15 pm - Soil test and raising mower blade demonstration

6:15 - 6:45 pm - *Stormwater-friendly landscaping design*, Annie White, Owner of NECTAR Landscape Design and Consulting

6:45 - 7:15 pm - *DIY Green Stormwater Infrastructure – Sink it, Spread it, Store It*, Becky Tharp, Program Manager of Green Infrastructure Collaborative, Vermont Department of Environmental Conservation and Lake Champlain Sea Grant

7:15 - 7:30 pm - Wrap up and questions, announce compost winners, take rain barrels

Some of the topics covered in this event include:

- Soil testing and analyzing test results
- Benefits of and how to aerate your lawn
- Benefits of mowing high and how to raise mower blade demo
- Benefits of and how to utilize smart watering techniques
- Smart fertilizer/pesticide use and alternatives
- Designing stormwater-friendly landscapes
- Selecting the right plant for the right place
- Implementing No Mow zones
- Planting native plants for wildlife and pollinators
- Benefits of rain gardens, rain barrels, and permeable pavement (GSI)
- Installing and maintaining GSI - siting, work involved, cost estimates
- Technical and financial resources available to help with GSI implementation

The incentives to encourage participation at this event were:

- Free admission
- Demonstration for how to take a soil test and raise mower blade
- Free rain barrel
- Free High Mowing seeds packets
- Chance to win compost bin and cubic yard of compost from Green Mountain Compost

Surveys were administered and collected at the end of the event. Suggestions for future workshops based on these surveys include lengthening the workshop to include a hands-on rain barrel building segment. Inviting participants to take soil tests prior to the workshop would be a great opportunity to analyze results with experts. Finally, incorporating a “Lawn Care Management Plan” development opportunity would be a great way to encourage the adoption of stormwater-friendly practices. Participants who pledge to adopt practices could be visited a year after implementing their plan and receive some kind of recognition for their dedication



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to environmental stewardship. There may be an opportunity to partner with Lake Champlain International's BLUE certification program to bring this idea to fruition.

The estimated cost to plan and carry out this workshop was \$3,670. Personnel time used to plan and execute the project was 74.25 hours or \$2,970. The total to provide free rain barrels for the event cost roughly \$575, the refreshments for the event cost \$106, and mileage was \$19. The total amount spent on this project was about 15% of RRST's total FY18 budget.



*Lawn care demonstrations lead by Kris Stepnuck (left) and Stormwater-friendly landscaping talk led by Annie White (pictured right)*



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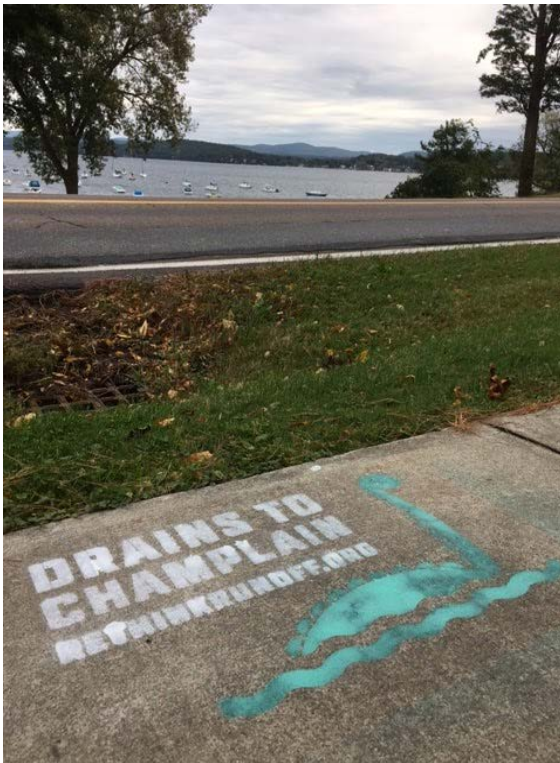


## **Town of Colchester Project: Storm drain stenciling and CHS stormwater lesson**

RRST elected to undertake another storm drain stenciling event this year to redo fading stencils along West Lakeshore Drive as Colchester's 2017 project. Outreach to elicit volunteers was conducted via Front Porch Forum and a handful of volunteers signed on for the project. All backed out last minute; presumably due to the chilly weather forecasted for this date. With help from Karen Adams from the Town's Public Works Department, the stenciling was conducted as planned on 9/30 and all suitable catch basins along West Lakeshore Drive were re-stenciled.

To make up for the lack of engagement in the Colchester project, a stormwater lesson was taught to the environmental science class at Colchester High School on 12/1/2017, with a total of eight participants.

The estimated cost to plan and carry out the stenciling and lesson was approximately \$1,125. Personnel time used to plan and execute the project was roughly 24 hours or \$960. The total supplies and half the stencil cost (the other half included in Essex Jct project budget) was roughly \$145, and the mileage was \$20. The total amount spent on this project was around 5% of RRST's total FY18 budget.



*Colchester stenciling on West Lakeshore Drive*



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## Water Quality Monitoring Program Summary

RRST has maintained an ongoing water quality monitoring program since 2012. These urban or suburban streams are impacted by sedimentation, excessive nutrient loading, high temperatures, bacteria, and other pollution. With another year of support from VT DEC's LaRosa program, RRST collected biweekly water quality samples at eighteen sites on nine streams in 2017. Twelve volunteers helped collected grab samples on five, biweekly Tuesdays from 6/27 - 8/22. Grab samples were analyzed for turbidity, total phosphorus, and chloride. These parameters were also sampled at five of the sites during two rain events on 7/17 and 8/18. See the 2017 Water Quality Monitoring Report in Appendix A for more information.

A required, sampling training was given to RRST's 17 volunteers on 6/20/17. All volunteers returned their samples to the WNRCD office after sampling, and the RRST coordinator ensured all samples were accounted for and delivered to the UVM lab. At the end of the sampling season, a pizza party was held on 9/30/17 to recognize and appreciate the volunteers for their efforts.

<i><b>Stream</b></i>	<i><b>Location</b></i>	<i><b>Site ID</b></i>	<i><b>Lat / Long</b></i>
<b>Centennial Brook</b>	Grove Street in Burlington	Centennial 10	44.48453 / -73.18423
	Patchen Road in South Burlington	Centennial 20	44.44872 / -73.14851
<b>Indian Brook</b>	Essex High School	Indian 10	44.49668 / -73.11093
	Lang Farm in Essex	Indian 20	44.50442 / -73.09190
<b>Malletts Creek</b>	McMullen Road	Malletts 10	44.60779 / -73.20103
<b>Munroe Brook</b>	Route 7 and Bay Road	Munroe 10	44.38987 / -73.21730
	Spear & Webster Intersection	Munroe 20	44.38984 / -73.20103
<b>Morehouse Brook</b>	Landry Park Winooski	Morehouse 10	44.50037 / -73.19370
<b>Muddy Brook</b>	River Cove Road in Williston	Muddy 10	44.47293 / -73.13505
	Marshall Ave in Williston	Muddy 20	44.45340 / -73.13833
	Van Sicklen Road in Williston	Muddy 30	44.42823 / -73.14622
<b>Potash Brook</b>	Kindness Court in South Burlington	Potash 10	44.44572 / -73.21348
	Farrell Street in South Burlington	Potash 20	44.44660 / -73.20415
	Dorset Street in South Burlington	Potash 30	44.45150 / -73.17849
	Tilley Drive South Burlington	Potash 40	44.44873 / -73.14849
<b>Engelsby Brook</b>	Pine St in Burlington	Engelsby 10	44.45627 / -73.21394
	Behind Redstone Campus in Burlington	Engelsby 20	44.47411 / -73.17354
<b>Smith Hollow Brook</b>	Off the Bike Path on Julie Drive	Smith Hollow 10	44.53926 / -73.20439

Table 2: 2017 Stream Sampling Site Locations



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*Sampling at Indian 20 on July 11, 2017*

## **Adopt-a Rain Garden Program Summary**

The Stream Team's Adopt-a-Rain Garden program is an opportunity for individuals to assist in keeping Chittenden County's public rain gardens functional and attractive. This involves basic maintenance activities like picking up trash, pruning, pulling weeds, installing new mulch, and informing the coordinator of non-functioning gardens. There are currently eleven public rain gardens managed by RRST. In 2017, there were four official adopters, but an estimated 78 more students and parents volunteered time to clean RRST gardens this year. Six of the eleven gardens were unattended this year. Efforts will be made in 2018 to find more scouts or student groups to adopt these gardens.



*South Burlington library and Fire Station rain garden cleanup on 9/16/17*



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An assessment of each garden was conducted in fall 2017 and the status of each is provided below:

### **Brownell Library Rain Garden**

**Location:** 6 Lincoln St. Essex Junction

This garden has existed for many years and has several mature shrubs. Unfortunately, several of the mature shrubs are the invasive burning bush (*Euonymus alatus*). Additional plants and mulch were added to the garden in 2013 and 2014. It was weeded and well-maintained in 2013, 2014 and 2015 but has not had an active adopter since that time. RRST intends to work with the Village of Essex Junction to remove the invasive plants and seek replacement shrubs, and will also seek a new individual or student/scouts group to adopt this garden in 2018. There is a RRST sign at this garden.

### **Callahan Park Rain Garden**

**Location:** Locust St., Burlington

This garden has been functioning well for some time thanks to efforts by Brad Ketterling, who has adopted this garden for several, consecutive years. In 2017, Burlington Public Works brought a load of mulch to the garden and Brad spread the mulch and kept up with weeding and monitoring the garden. Several, understory shrubs and flowers have been shaded out by larger, over-story plants that need to be thinned. There are several locations that also need to be replanted, so efforts will be made to locate surplus plants that can be added in 2018. There is a RRST sign at this garden.

### **Chamberlain School**

**Location:** 262 White Street, South Burlington

This garden was installed in partnership with WNRCD and the Let it Rain Program in 2013. This is one of several rain gardens on the grounds of Chamberlain Elementary. School teacher Chris Provost adopted this garden again in 2017 and has actively maintained it for several years. Additional effort was made this year to dig out and separate several flower clumps to replant in bare spots in the garden, with help from 20+ students and staff from the school. A RRST sign was also installed this year.

### **Coast Guard Station**

**Location:** Depot Street, Burlington

This small garden is located in the parking lot abutting the bike path next to the Burlington Coast Guard Station. In 2014, RRST worked with the ECHO summer kids program to engage elementary school children in cleaning the garden and in 2015 a local resident, Wiley Reading, adopted the garden. The garden did not have an adopter in 2016 and 2017, and has become overgrown and choked with debris. Effort will be made to reconnect with ECHO in 2018 to request assistance with weeding, thinning, replanting, and removing trash from this garden. There is a RRST sign at this garden.

### **Correctional Facility**

**Location:** 7 Farrell St., South Burlington

This garden is visible from the road and appears to be functioning well. Originally, employees of the prison adopted this garden and would occasionally clean the garden with inmates. There has been a lot of staff turnover in the past few years without a clear adopter. No formal adoption of this garden was made in 2017.



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RRST will attempt to make contact with the Correctional Facility staff to gauge their interest in reinitiating inmates with this work in 2018, as the garden has become overgrown and is bare in some spots. There is not a RRST garden sign at this garden, but one will not be installed here as visiting the area is discouraged.

### **Farrell Park**

**Location:** Swift Street, South Burlington

This garden is unique in terms of its design. It is called an “advanced wetland stormwater filter” and was installed in 2012. Stormwater enters the garden through an inlet, flows through the gravel wetland filter media, is cleaned and exits through other end. The garden requires very little maintenance because it has a flushing system that prevents sediment from building up. This garden had an active adopter for its entire life, until 2015 when the adopter moved away. The garden was never in need of additional plants or maintenance. It would not be appropriate to add mulch to this garden. RRST would like to find another adopter in 2018, primarily to weed the site and to bring any issues to our attention.

### **Landry Park**

**Location:** North St., Winooski

This garden was constructed in 2006 as two, separate gardens along the narrow strip of grass between a fence at Landry Park and the road. Over the years, the garden has fallen into disrepair. A few years ago, nearby road construction altered the slope of the road carrying larger volumes of water into the garden. The increased flows have killed some of the vegetation and caused gullies to form, but the vegetation seems to have rebounded. It would be beneficial to the functionality of the garden to have the sediment vacuumed out and RRST will attempt to coordinate with the City of Winooski to conduct this work in 2018. In 2016, a group of UVM students in an Ecosystem Design course developed recommendations to repair the garden. There is no current adopter; and RRST coordinator will attempt to find one for the 2017 growing season. There is not currently a RRST sign at this garden.

### **Williston Town Hall Annex**

**Location:** 7900 Williston Rd, Williston

This small garden near the entrance walkway to the Annex building and the parking lot has had an active adopter since 2014. Rita Desseau maintained the garden in 2017, but additional work needs to be done at this site to weed, thin larger shrubs, re-plant in bare spots, and mulch the garden. Rita will likely agree to care for the garden again in 2018, but the RRST coordinator will attempt to organize a school group from Williston Central School to help with a rain garden cleanup this year. There is a RRST sign at this garden.

### **Williston Library**

**Location:** 21 Library Lane, Williston

This garden had an active adopter for many years, but Andrew Wolf did not adopt the garden in 2017. Although there is a good layer of mulch, the garden needs to be thinned in some locations and replanted in others. RRST coordinator will also inquire about getting assistance from Williston Central School to help clean up both this and the Annex rain garden in 2018.



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### **South Burlington Library**

540 Dorset St., South Burlington

WNRCDC received a grant to construct a rain garden at the entrance to South Burlington Library in 2013. The rain garden received minimal maintenance by the library staff over the years, and was formally adopted in 2016 by Amy Niggel's Cub Scout 678 pack. The pack's leadership changed hands in 2018 and the new cubmaster Bill Kett agreed to continue maintenance of the garden with his pack. The garden weeded and plants thinned on 9/21. There is a RRST sign at this garden.

### **South Burlington Fire Department**

575 Dorset St., South Burlington

The City of South Burlington installed this bioretention area/rain garden in 2015 to improve stormwater management at the Fire Department. The Cub Scout pack volunteered to adopt this rain garden as well in 2018, and rain garden cleanup day was held on 9/21 with help from 58 people to plant the following donated plants: Yellow bearded iris, Joe Pye weed, Swamp milkweed, Lobelia, Ostrich fern, Turtlehead, and Shasta daisy. These flowers were donated by two, local residents and hand-pulled and delivered with help from local, gardener Anne Pearce. There is not currently a RRST sign at this garden.

<b>Rain Garden</b>	<b>Adopter</b>	<b>Previous adopters</b>
Chamberlin School, South Burlington	Chris Provost and students	Chris Provost
Coast Guard Station, Burlington	None	Wily Reading
Landry Park, Winooski	None	None
Williston Annex	Rita Dessau	Rita Dessau
Williston Town Library	None	Andrew Wolf
Callahan Park, Burlington	Brad Ketterling	Brad Ketterling
Farrell Park, South Burlington	None	None
Department of Corrections, South Burlington	None	Dana Scofield and Lori Farley
Brownell Library, Essex	None	None
South Burlington Fire Station	Cub Scouts 678 (Bill Kett)	Cub Scouts 678 (Amy Niggel)
South Burlington Library	Cub Scouts 678 (Bill Kett)	None

**Table 3: 2017 Rain Garden Adopters**



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## 2017 Water Quality Monitoring Report

### Monitoring Team

The Rethink Runoff Stream Team (formerly the Chittenden County Stream Team) is a program that engages citizens across a nine-town region to implement projects that reduce non-point source pollution and stormwater volume at the local level. The participating towns are Burlington, Colchester, Essex, Essex Junction, Milton, Shelburne, South Burlington, Williston, and Winooski. The Water Quality Monitoring program is managed by the Chittenden County's Municipal Stormwater Separate System Committee, coordinated by the Winooski Natural Resources Conservation District, and made possible through the support of the Vermont Department of Environmental Conservation LaRosa program. This report describes the results from the 2017 collection season; the sixth, consecutive year data was collected by this volunteer-led stream water quality monitoring effort in Chittenden County.

### When, Where, and What the Stream Team Monitors

The Rethink Runoff Stream Team (RRST) has collected biweekly water quality samples at several pollutant “impaired” or “stressed” stream sites in Chittenden County since 2012. These urban or suburban streams suffer from excessive nutrient loads, sodium chloride, sedimentation, high temperatures, bacteria, and/or other pollutants. Samples were collected on seven different dates in 2017: on five, scheduled bi-weekly dates and on two “high-flow” dates (i.e. during a rain event). High-flow sampling provides a snapshot of the potentially, elevated or diluted pollutant-loads moving through these systems when it rains. Samples were taken and analyzed for turbidity, total phosphorus, and chloride at all 18 sites. The specific sampling sites and their locations are listed in Table 1 and a map of the sites is shown in Figure 1.

Biweekly sampling dates occurred on: June 27<sup>th</sup>, July 11<sup>th</sup>, July 25<sup>th</sup>, August 8<sup>th</sup>, and August 22<sup>nd</sup>. Rain event sampling or “high-flow” (freshet) events occurred at sites on Indian, Muddy, Potash, Centennial and Morehouse Brooks on July 17<sup>th</sup> and August 18<sup>th</sup>. Nearly an inch of precipitation fell from July 23-25, therefore the 25th sampling date is classified as a highflow event. All other biweekly sampling dates fell during dry conditions or baseflow events.



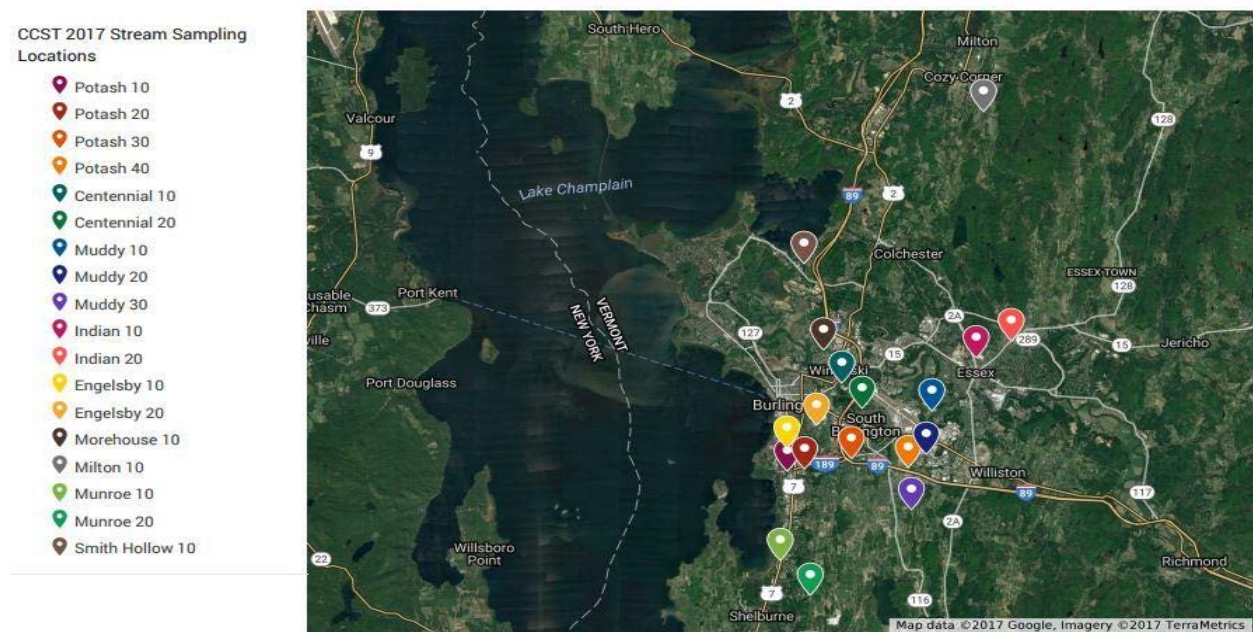
Report prepared by:  
Holly Kreiner, Conservation Specialist  
Winooski Natural Resources  
Conservation District



Funded by: LaRosa Partnership, VT  
Department of Environmental Conservation  
Watershed Management Division

**Table 1. Chittenden County Stream Team 2017 Water Quality Sampling Sites**

<i>Stream</i>	<i>Location</i>	<i>Site ID</i>	<i>Lat / Long</i>
<b>Centennial Brook</b>	Grove Street in Burlington	Centennial 10	44.48525 / -73.18340
	Patchen Road in South Burlington	Centennial 20	44.47411 / -73.17354
<b>Indian Brook</b>	Essex High School	Indian 10	44.49668 / -73.11093
	Lang Farm in Essex	Indian 20	44.50442 / -73.09190
<b>Malletts Creek</b>	McMullen Road	Malletts 10	44.60779 / -73.20103
<b>Munroe Brook</b>	Route 7 and Bay Road	Munroe 10	44.40453 / -73.21729
	Spear & Webster Intersection	Munroe 20	44.38984 / -73.20103
<b>Morehouse Brook</b>	Landry Park Winooski	Morehouse 10	44.50037 / -73.19370
<b>Muddy Brook</b>	River Cove Road in Williston	Muddy 10	44.47293 / -73.13505
	Marshall Ave in Williston	Muddy 20	44.45340 / -73.13833
	Van Sicklen Road in Williston	Muddy 30	44.42823 / -73.14622
<b>Potash Brook</b>	Kindness Court in South Burlington	Potash 10	44.44572 / -73.21348
	Farrell Street in South Burlington	Potash 20	44.44660 / -73.20415
	Dorset Street in South Burlington	Potash 30	44.45150 / -73.17849
	Tilley Drive South Burlington	Potash 40	44.44873 / -73.14849
<b>Englesby Brook</b>	Pine St in Burlington	Englesby 10	44.45627 / -73.21394
	Behind Redstone Campus in Burlington	Englesby 20	44.46636 / -73.19774
<b>Smith Hollow Brook</b>	Off the Bike Path on Julie Drive	Smith Hollow 10	44.53926 / -73.20439



**Figure 1 - 2017 Rethink Runoff Stream Team Water Quality Monitoring Sites**



## Phosphorus Results

Phosphorus is an essential nutrient for plants and animals that is naturally limited in most freshwater systems. Even a modest increase can set off a chain of undesirable events, such as algal blooms, accelerated plant growth, low dissolved oxygen, and the subsequent die off of aquatic life. Although phosphorus naturally occurs in soils and rocks, additional phosphorus enters waterways through runoff from sources such as fertilized lawns and cropland, pet waste, failing septic systems, animal manure from storage areas or livestock access, wastewater treatment plants, and streambank erosion. The VT water quality standard for phosphorus in Class B warm water medium-gradient streams is 27 µg/L.

**Table 2. 2017 RREST Phosphorus Results Summary:** This table depicts mean phosphorus levels in µg/L during both baseflow (dry) and high-flow (rain) sampling events in 2017. Overall mean values exceeding the Vermont chronic chloride standard of 27 µg/L are shown in red. Raw data is presented in Appendix C.

Location	Average Phosphorus during Baseflow - Dry Conditions	Average Phosphorus during Rain Events	Average Phosphorus Concentrations
Centennial 10	51.53	372.77	212.15
Centennial 20	101.5	--	--
Englesby 10	71.3	--	--
Englesby 20	89.85	--	--
Indian 10	39.88	54.57	47.23
Indian 20	43.8	--	--
Mallets Creek 10	32.73	--	--
Munroe 10	51.68	--	--
Munroe 20	46.95	--	--
Morehouse 10	26.28	85.23	55.76
Muddy 10	72	--	--
Muddy 20	65.63	88.7	77.17
Muddy 30	71.25	--	--
Potash 10	42.85	--	--
Potash 20	43.13	59.8	51.47
Potash 30	52.15	--	--
Potash 40	95.45	--	--
Smith Hollow 10	48.57	--	--

Mean baseflow phosphorus levels exceeded the proposed Vermont state standard of 27 µg/L at all sites in 2017, except on Morehouse Brook. However, the four averaged baseflow dates and three averaged freshet events at Morehouse Brook nearly doubled the standard as seen with other sites. The upstream sites on Englesby, Centennial, and Potash Brooks added in 2017 all show the highest levels of baseflow phosphorus; even higher concentrations than in downstream sites. In 2017, Centennial 10 near the mouth displayed the highest mean phosphorus concentration at just over 212 µg/L; nearly seven times the



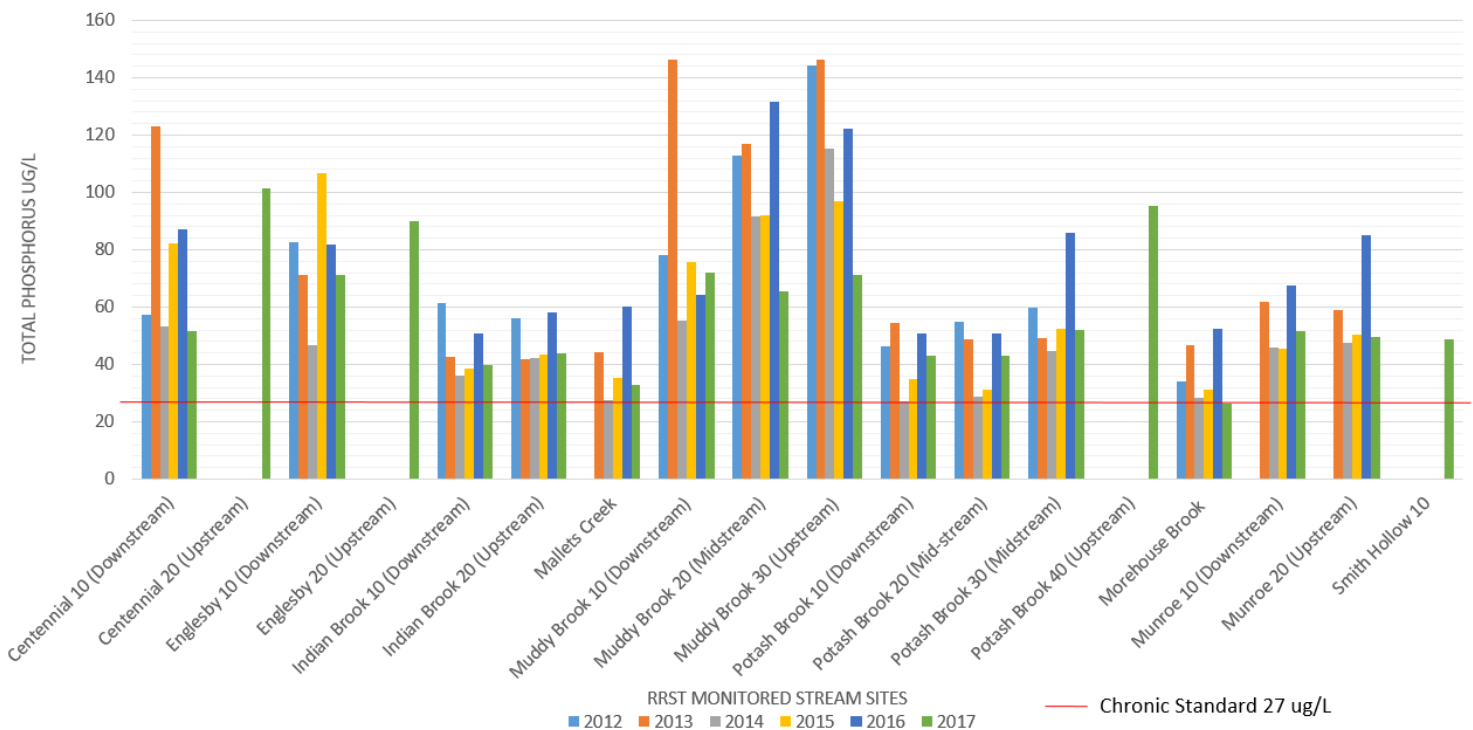


standard. Centennial 20 displayed the highest baseflow phosphorus at a mean concentrations of 101.5 µg/L.

### Phosphorus levels in Chittenden County Streams 2012-2017

Since the onset of this monitoring program in 2012, mean concentrations of phosphorus during baseflow have remained significantly above the 27 µg/L standard at all stream sites. There was a reduction in phosphorus levels in 2017, but sites still retain levels two or three times the standard in the majority of cases.

Average Total Phosphorus in RRST monitored streams from 2012-2017 - Baseflow conditions only



**Figure 2 - Comparison of Mean Total Phosphorus Levels 2012-2017 during Baseflow Conditions.**

The State of Vermont's base-flow phosphorus standard is 27 µg/L for class B, "warm water medium-gradient" streams is shown by the red line. Note: an assumption was made that most of the streams monitored by the RRST would fall under the first category, although the streams monitored are not listed as warm-water streams in the 2014 Vermont Water Quality Standards.



## Chloride Results

Chloride is a component of salt found naturally in minerals and in oceans. While a low level of instream chloride can originate from natural sources, higher levels are generally due to the use of deicing salts. Elevated chloride levels in surface waters can negatively impact the health and reproduction of aquatic species, according to the Vermont Surface Water Management Strategy. The Environmental Protection Agency's (EPA) and State of Vermont's (VT) current water quality standard for chloride is 230 mg/L (chronic criteria) and 860 mg/L (acute criteria). This is the concentration of chloride above which chronic or acute health effects have been observed in of aquatic species.

**Table 3. 2017 RREST Chloride Results Summary:** This table depicts mean chloride levels in mg/L during baseflow (dry) and high-flow (rain) sampling events in 2017. Overall mean values exceeding the Vermont chronic chloride standard of 230 mg/L are shown in red. Raw data is presented in Appendix C.

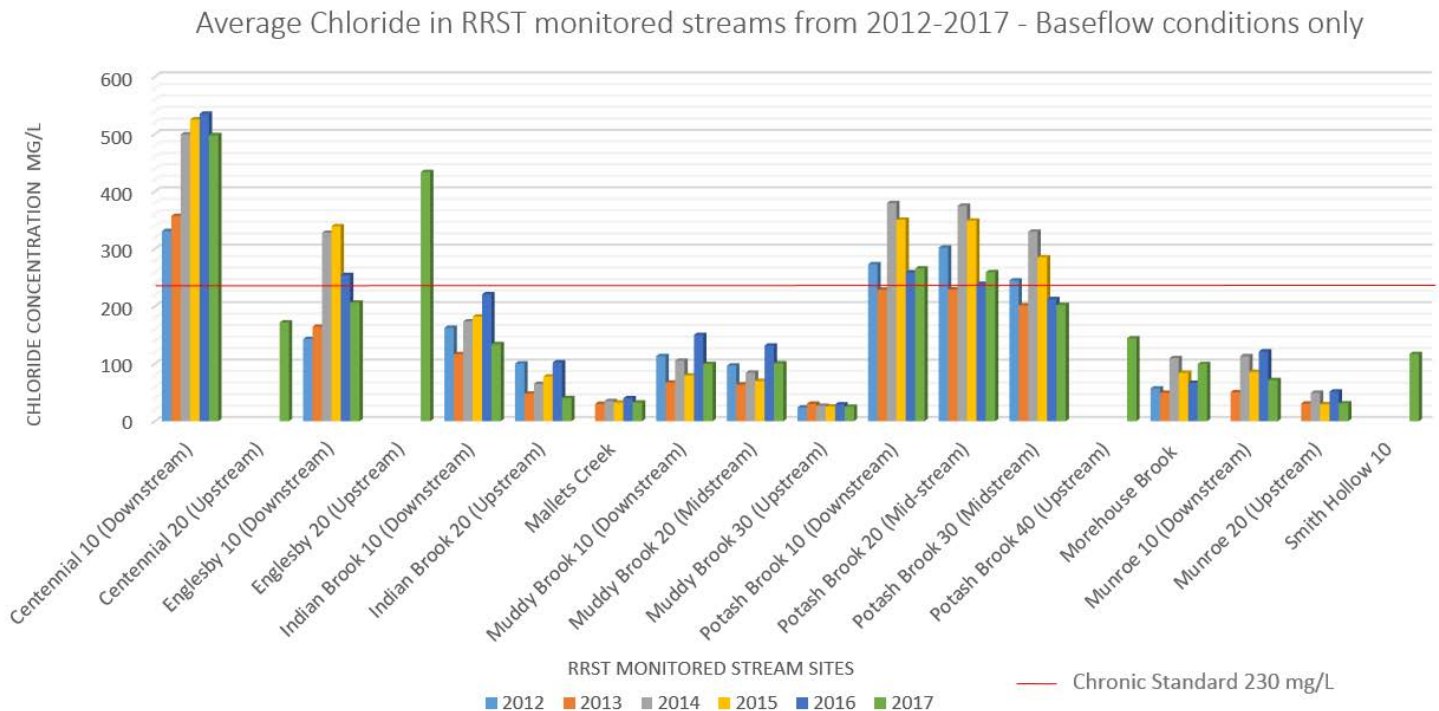
Site ID	Average Chloride in Dry Conditions Only	Average Chloride during Rain Events	Average Chloride Concentrations
Centennial 10	498.13	368	433.07
Centennial 20	172	--	--
Englesby 10	206.4	--	--
Englesby 20	434	--	--
Indian 10	134	108.77	121.39
Indian 20	40.15	--	--
Mallets Creek 10	32.58	--	--
Munroe 10	71.63	--	--
Munroe 20	31.05	--	--
Morehouse 10	99.5	77.27	88.39
Muddy 10	99.5	--	--
Muddy 20	100.63	85.2	92.92
Muddy 30	25.05	--	--
Potash 10	266	--	--
Potash 20	259.5	275.33	267.42
Potash 30	202.3	--	--
Potash 40	144.23	--	--
Smith Hollow 10	117	--	--

Mean baseflow chloride levels exceeded the proposed Vermont state standard of 230 mg/L in Centennial, Englesby, and Potash Brooks in 2017. As suspected, chloride levels were higher during baseflow conditions in the majority of cases due to dilution. Centennial Brook showed the highest chloride level again in 2017, with a mean baseflow concentration of over 498 mg/L. The newly added upstream site on Englesby also displayed an average concentration nearly twice the standard (434 mg/L).



## Chloride levels in Chittenden County Streams 2012-2017

Since the onset of this monitoring program, mean chloride levels at Centennial 10 have remained significantly above 230 mg/L standard. Standards were surpassed in four out of the six years in Englesby Brook and in five of the six years in Potash Brook; both of which include 2017 results. Chloride levels did not exceed the EPA's and VT's acute standard, which is 860 mg chloride/L, in any individual sample over this six year period.



**Figure 3 - Mean Chloride Levels in Chittenden County Streams 2012-2017.** EPA's and Vermont's standard for 4-day average chloride levels (230 mg/L) is shown by the red line.

## Turbidity Results

The turbidity of a water sample refers to its cloudiness. This measurement is based on the amount of algae, microbes, and sediment suspended in the water. High turbidity levels can negatively impact aquatic life by raising water temperature, decreasing forage and cover, and harming gill function, and has the potential to increase the presence and number of disease-causing organisms. Turbidity measurements can also be used as an indicator for erosion and increased nutrient levels in streams. The Vermont Water Quality Standards state that turbidity should not exceed 10 NTU (nephelometric turbidity units) in cold-water fish habitat and 25 NTU in warm-water fish habitat.





**Table 4. 2017 RRST Turbidity Results Summary:** This table depicts mean turbidity levels in NTU baseflow (dry) and high-flow (rain) sampling events in 2017. Overall mean values exceeding the Vermont standard of 25 NTU are shown in red. Raw data is presented in Appendix C.

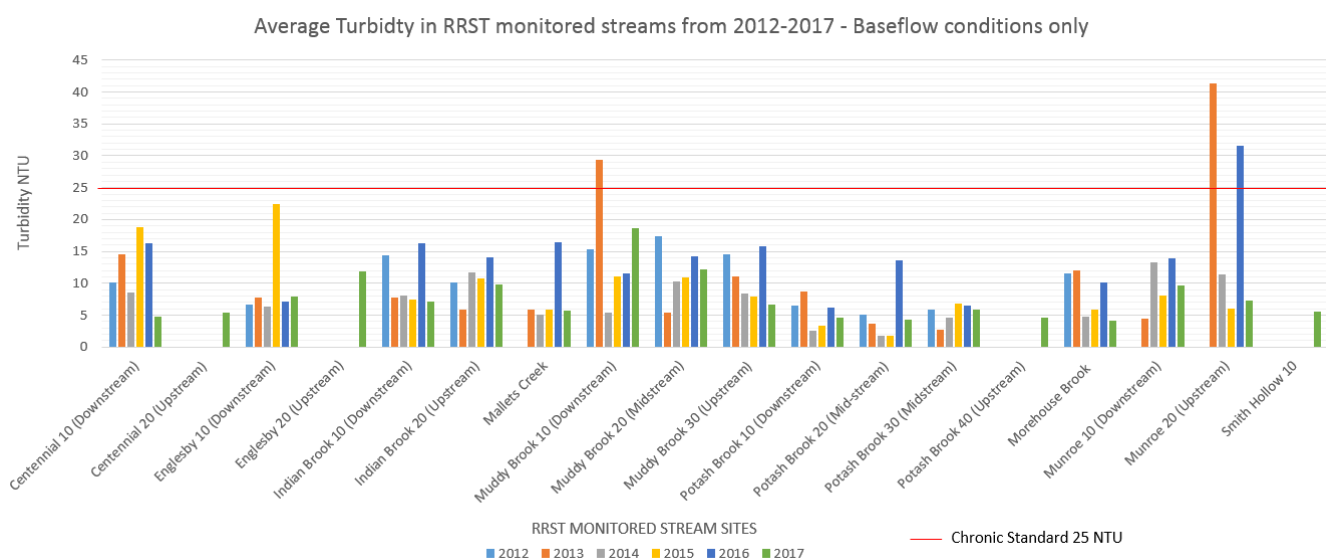
Site ID	Average Turbidity in Dry Conditions Only	Average Turbidity during Rain Events	Average Turbidity Concentrations
Centennial 10	4.81	159.7	82.26
Centennial 20	5.43	--	--
Englesby 10	7.88	--	--
Englesby 20	11.93	--	--
Indian 10	7.1	11.41	9.26
Indian 20	9.78	--	--
Mallets Creek 10	5.77	--	--
Munroe 10	9.72	--	--
Munroe 20	5.5	--	--
Morehouse 10	4.2	34.03	19.12
Muddy 10	18.7	--	--
Muddy 20	12.12	32.14	22.13
Muddy 30	6.67	--	--
Potash 10	4.59	--	--
Potash 20	4.27	19.27	11.77
Potash 30	5.91	--	--
Potash 40	4.54	--	--
Smith Hollow 10	7.35	--	--

Mean baseflow turbidity levels did not exceed the VT Water Quality standard for turbidity of 25 nephelometric units (NTU) for warm-water fish habitat in 2017. As suspected, turbidity concentrations were higher during rain events, and surpassed standards on Centennial, Muddy, and Morehouse Brooks. The only stream site of concern is Centennial 10, where averaged baseflow and highflow events showed results over twice the standard (82.26 NTU).

#### **Turbidity Levels in Chittenden County Streams 2012-2017**

Mean baseflow turbidity values only exceeded the VT standard for warm-water streams of 25 NTU in Centennial (in 2013) and Munroe Brooks (in 2013 and 2016) over the six year sampling period. Mean turbidity levels surpassed the 10 NTU standard for cold-water fish habitat in all streams from 2012 – 2017.





**Figure 4 - Comparison of Mean Turbidity Levels 2012-2017 during Baseflow (dry) Conditions.** The standard proposed by the State of Vermont for mean turbidity at baseflow in medium gradient, warm water streams (25 NTU) is indicated by the red line.

## Conclusion

The Rethink Runoff Stream Team has monitored chloride, phosphorus, and turbidity in various stormwater-impaired streams in Chittenden County for the past six, consecutive years (2012-2017). The 2017 season's results are similar to those obtained over the past six years, and indicate that all stream sites have sustained phosphorus levels well above the Vermont standard and that chloride is becoming a prevalent and growing concern.

Phosphorus levels in all eight streams have remained two to four times the Vermont water quality standard of 27  $\mu\text{g/L}$ . Muddy Brook continues to maintain high levels of phosphorus; however, Centennial and Englesby Brooks showed even higher concentrations than Muddy Brook in 2017. The newly, added upstream site on Potash Brook also displayed high concentrations of phosphorus.

Chloride levels continue to surpass standards in several streams, most notably in Centennial Brook where the average chloride concentration in 2017 was more than double the Vermont chronic standard. The upstream site on Englesby also displayed high concentrations of chloride. As in previous years, chloride concentrations in Potash Brook surpassed standards in 2017, pointing to a growing concern in this watershed as well.

While turbidity has shown slight elevations in Munroe and Muddy Brooks over the past six years, this pollutant does not appear to be a concern in these Chittenden County streams.



As in previous years, concentrations of phosphorus tend to be higher during rain events, while chloride shows lower concentrations due to dilution. Going forward, RRST will continue to monitor and compare results between baseflow and high-flow conditions to better capture and understand the pollutant loads moving through these stream systems during and immediately after rainfall. Climatologists predict that the Northeast will continue to experience increased and more flashy rain events in future years, so it is important to understand how these stream systems will be affected.

After six years of showing minimal concern, turbidity will be abandoned at most locations in the 2018 season. In its place, additional sites will be added on new streams, to determine the spatial and temporal trends of phosphorus and chloride concentrations. Effort will also be made to identify suitable locations for source-bracket monitoring, to determine specific areas that may be contributing pollution.



## Appendix A. Quality Assurance Measures for phosphorus, chloride, and turbidity in 2017

Site ID	Date	Sample Type	Relative Percent Difference Between Duplicate Pairs
Muddy 10	6/27/18	Chloride	1.6%
		Phosphorus	5.5%
		Turbidity	3.4%
Indian 10	7/11/18	Chloride	1.9%
		Phosphorus	0.57%
		Turbidity	14.4%
Potash 10	7/11/18	Chloride	0.78%
		Phosphorus	0.92%
		Turbidity	9.8%
Munroe 20	7/25/18	Chloride	0%
		Phosphorus	0.69%
		Turbidity	14%
Centennial 10	7/25/18	Chloride	1.2%
		Phosphorus	4.2%
		Turbidity	4.3%
Englesby 10	8/8/18	Chloride	1.5%
		Phosphorus	0.52%
		Turbidity	1.72%
Mallets 10	8/8/18	Chloride	2.1%
		Phosphorus	1.36%
		Turbidity	9.92%
Indian 10	8/22/18	Chloride	8.15%
		Phosphorus	6.13%
		Turbidity	16.3%
Muddy 30	8/22/18	Chloride	13.2%
		Phosphorus	2.2%
		Turbidity	3.2%
Centennial 10 (rain)	8/18/18	Chloride	4.9%
		Phosphorus	0.38%
		Turbidity	1.3%
Mean Relative Percent Difference		Chloride	3.53 %
		Phosphorus	2.25 %
		Turbidity	7.83 %

Target RPD for duplicate field samples:

Chloride  $\leq 5\%$ ,      Phosphorus  $\leq 30\%$ ,      Turbidity  $\leq 15\%$ ,



## Appendix B – 2017 Project Completeness

Parameter	Number of Samples Anticipated	Number of Valid Samples Collected & Analyzed	Percent Complete
Chloride	120	117	98
Total phosphorus	120	117	98
Turbidity	120	117	98

## Appendix C – 2017 Individual Sample Results

Sample Number	Location	Date	Chloride (mg/L)	TP(ug P/L)	Turbidity (NTU)
171194-20	Muddy 30 - Blank	08/22/2017	< 2	< 5	< 0.2
171194-19	Muddy 30 - Dup	08/22/2017	28.08	92.9	12.8
171194-03	Muddy 30	08/22/2017	24.6	90.9	12.4
171194-17	Malletts 10	08/22/2017	43.2	34.4	5.59
171194-16	Morehouse 10	08/22/2017	118	21.9	4.32
171194-15	Centennial 20	08/22/2017	206	75	3.69
171194-14	Centennial 10	08/22/2017	624	41.2	3.38
171194-13	Englesby 20	08/22/2017	398	163	4.31
171194-12	Englesby 10	08/22/2017	160	103	11.2
171194-11	Monroe 20	08/22/2017	38.1	43.7	6.92
171194-10	Monroe 10	08/22/2017	79.5	51.4	6.8
171194-09	Indian 20	08/22/2017	79.5	49.3	13.8
171194-08	Indian 10	08/22/2017	212	37	4.62
171194-21	Indian 10 - Dup	08/22/2017	230	34.8	5.44
171194-22	Indian 10 - Blank	08/22/2017	< 2	< 5	0.22
171194-07	Potash 40	08/22/2017	98.6	90	7.01
171194-06	Potash 30	08/22/2017	234	48.7	3.75
171194-05	Potash 20	08/22/2017	276	39.7	2.31
171194-04	Potash 10	08/22/2017	272	36.8	3.12
171194-02	Muddy 20	08/22/2017	113	75.3	15.7
171194-01	Muddy 10	08/22/2017	126	63.2	16.4
171174-22	Smith Hollow 10	08/08/2017	114	62.8	9.04
171174-21	Malletts 100	08/08/2017	39.4	37	7.28
171174-12	Malletts 10 - Dup	08/08/2017	38.6	36.5	8.04
171174-11	Malletts 10 - Blank	08/08/2017	< 2	< 5	< 0.2
171174-20	Morehouse 10	08/08/2017	77	32.3	5.06
171174-19	Centennial 20	08/08/2017	225	118	10.9
171174-18	Centennial 10	08/08/2017	420.5	62.3	6.97
171174-17	Englesby 20	08/08/2017	352.5	63.8	5.62



171174-16	Englesby 10	08/09/2017	266	57.8	7.02
171174-06	Englesby 10 - Dup	08/09/2017	270	58.1	6.9
171174-05	Englesby 10- Blank	08/09/2017	< 2	7.68	< 0.2
171174-15	Monroe 20	08/08/2017	32.2	52.2	12.1
171174-14	Monroe 10	08/08/2017	88.6	62.5	13.4
171174-13	Indian 20	08/08/2017	41.4	50.7	14.7
171174-10	Indian 10	08/08/2017	135	53.7	10.6
171174-09	Potash 40	08/08/2017	320	77.6	5.38
171174-08	Potash 30	08/08/2017	211	62.9	8.85
171174-07	Potash 20	08/08/2017	232	42.5	5.95
171174-04	Potash 10	08/08/2017	226	43.9	6.63
171174-03	Muddy 30	08/08/2017	27.4	79.5	6.32
171174-02	Muddy 20	08/08/2017	159	61.2	10.7
171174-01	Muddy 10	08/08/2017	135	67.8	17.9
170993-05	Centennial 10	07/17/2017	444	380	193.2
170993-04	Morehouse 10	07/17/2017	79.4	60.2	18.3
170993-03	Indian 10	07/17/2017	110	42.9	8.66
170993-02	Muddy 20	07/17/2017	73.5	54.2	10.7
170993-01	Potash 20	07/17/2017	322	44.9	11.3
170990-07	Potash 20 - Blank	08/18/2017	< 2	< 5	< 0.2
170990-06	Potash 20 - Dup	08/18/2017	268	78.9	38.9
170990-01	Potash 20	08/18/2017	255	79.2	38.4
170990-05	Centennial 10	08/18/2017	310	665	276.5
170990-04	Morehouse 10	08/18/2017	63	110.1	47.4
170990-03	Indian 10	08/18/2017	121	73.2	17.9
170990-02	Muddy 20	08/18/2017	83.1	152.7	77.3
170884-22	Monroe 20 - Blank	07/25/2017	< 2	< 5	< 0.2
170884-21	Monroe 20 - Dup	07/25/2017	62.5	58	13
170884-11	Monroe 20	07/25/2017	62.5	57.6	12.8
170884-20	Smith Hollow 10	07/25/2017	115	45.2	8.83
170884-19	Malletts 10	07/25/2017	30.8	27.3	3.61
170884-18	Morehouse 10	07/25/2017	89.4	85.4	36.4
170884-17	Centennial 20	07/25/2017	220	101	6.14
170884-16	Centennial 10-Blank	07/25/2017	< 2	< 5	< 0.2
170884-15	Centennial 10-Dup	07/25/2017	346	70.3	9.81
170884-14	Centennial 10	07/25/2017	350	73.3	9.4
Englesby	Englesby	07/25/2017	264	76.1	6.66
170884-12	Englesby 10	07/25/2017	157	133	25.7
170884-10	Monroe 10	07/25/2017	29.8	59.6	5.78



170884-09	Indian 20	07/25/2017	16.7	49.4	10.6
170884-08	Indian 10	07/25/2017	95.3	47.6	7.67
170884-07	Potash 40	07/25/2017	98.6	91	2.29
170884-06	Potash 30	07/25/2017	229	60.8	6.04
170884-05	Potash 20	07/25/2017	249	55.3	8.12
170884-04	Potash 10	07/25/2017	214	57.3	8.45
170884-03	Muddy 30	07/25/2017	25.2	63.4	6.02
170884-02	Muddy 20	07/25/2017	99	59.2	8.41
170884-01	Muddy 10	07/25/2017	107	68.4	16.5
170885-22	Smith Hollow 10	07/11/2017	110	37.2	3.24
170885-21	Malletts 10	07/11/2017	22.1	28.2	3.82
170885-20	Morehouse 10	07/11/2017	105	27	4.33
170885-19	Centennial 20	07/11/2017	123	101	4.29
170885-18	Centennial 10	07/11/2017	510	50.5	4.28
170885-17	Englesby 20	07/11/2017	495.5	73.1	8.77
170885-16	Englesby 10	07/11/2017	193.6	63	7.58
170885-15	Monroe 20	07/11/2017	29.79	47	6.07
170885-14	Monroe 10	07/11/2017	68.5	46.8	11.5
170885-13	Indian 20	07/11/2017	19.8	46.9	7.16
170885-12	Indian 10 Dup	07/11/2017	106	35.2	6.06
170885-11	Indian 10 Blank	07/11/2017	< 2	< 5	< 0.2
170885-10	Indian 10	07/11/2017	104	35	7
170885-09	Potash 40	07/11/2017	76.5	151	5.2
170885-08	Potash 30	07/11/2017	187.2	49.3	5.31
170885-07	Potash 20	07/11/2017	240	43.4	4.25
170885-06	Potash 10 Dup	07/11/2017	258	43.5	4.16
170885-05	Potash 10 Blank	07/11/2017	< 2	< 5	< 0.2
170885-04	Potash 10	07/11/2017	256	43.9	3.77
170885-03	Muddy 30	07/11/2017	23.5	47.4	3.59
170885-02	Muddy 20	07/11/2017	61.5	55.2	8.59
170885-01	Muddy 10	07/11/2017	67.5	62.9	13.7
170842-20	Smith Hollow 10	06/27/2017	127	45.7	4.22
170842-19	Malletts 10	06/27/2017	25.6	31.3	6.37
170842-18	Morehouse 10	06/27/2017	98	23.9	3.09
170842-17	Centennial 20	06/27/2017	134	112	2.84
170842-16	Centennial 10	06/27/2017	438	52.1	4.6
170842-15	Englesby 20	06/27/2017	490	59.5	29
170842-14	Englesby 10	06/27/2017	206	61.4	5.72
170842-13	Monroe 20	06/27/2017	24.1	44.9	4.31





170842-12	Monroe 10	06/27/2017	49.9	46	7.19
170842-11	Indian 20	06/27/2017	19.9	28.3	3.47
170842-10	Indian 10	06/27/2017	85	33.8	6.17
170842-09	Potash 40	06/27/2017	81.8	63.2	0.57
170842-08	Potash 30	06/27/2017	177	47.7	5.72
170842-07	Potash 20	06/27/2017	290	46.9	4.56
170842-06	Potash 10	06/27/2017	310	46.8	4.82
170842-05	Muddy 30	06/27/2017	24.7	67.2	4.37
170842-04	Muddy 20	06/27/2017	69	70.8	13.5
170842-03	Muddy 10-Blank	06/27/2017	< 2	5.95	< 0.2
170842-02	Muddy 10-Dup	06/27/2017	68.4	99.4	25.9
170842-01	Muddy 10	06/27/2017	69.5	94.1	26.8

